Oct 2010

Lowest Pressure | All time warm high temps Bozeman and Dillon

Nov 2010

Ear | Hu | Quietes | 95 | Snowiest Nov at several locations in MT – Millegan 52”

Dec 2010

Syr | Rec | L | Fir | N | Pa | One of snowiest of record: Glasgow; HVR/GTF high season

Jan 2011

24 | H | B | A | N Mex – | Glasgow – new monthly snowfall record – 41.6”

Feb 2011

C | 1 | I | V | I | South K | C | GTF – second wettest and snowiest Feb of record.

Mar 2011

M | T | F | 12-ft snow in | MT – cooler, but near normal precipitation.

Apr 2011

M | F | F | L | I | I | V | Record | MT – Flooding along the Milk River.

May 2011

F | J | M | Rare torna | I | C | H | Zortman – 16.44” precip – May record for Montana.

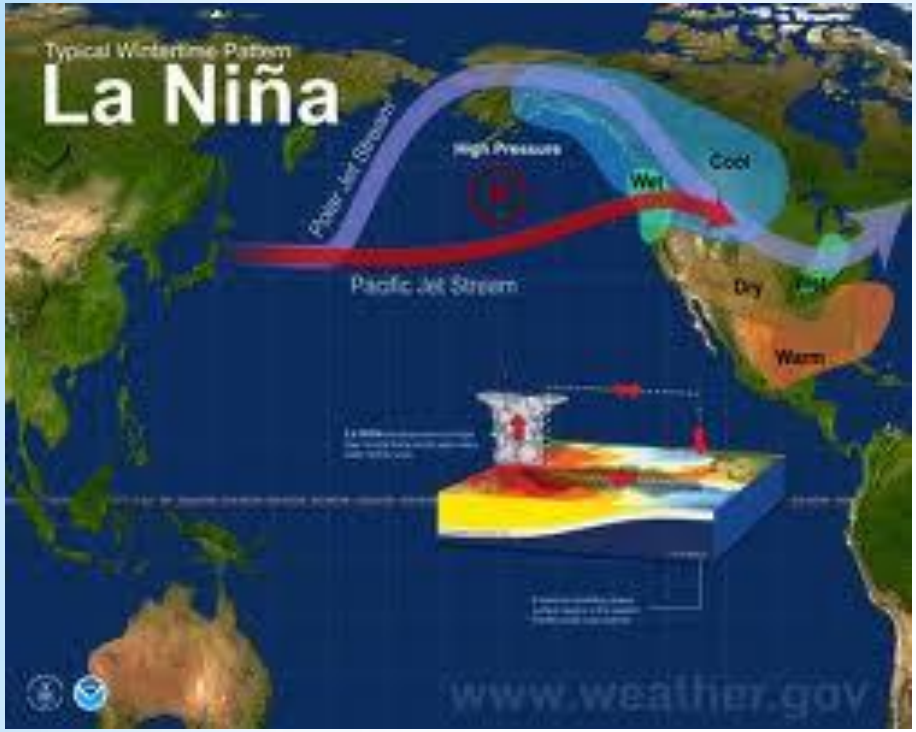
Jun 2011

I | Re | Drought, heat c | Flooding with high lake levels; late snowmelt records.

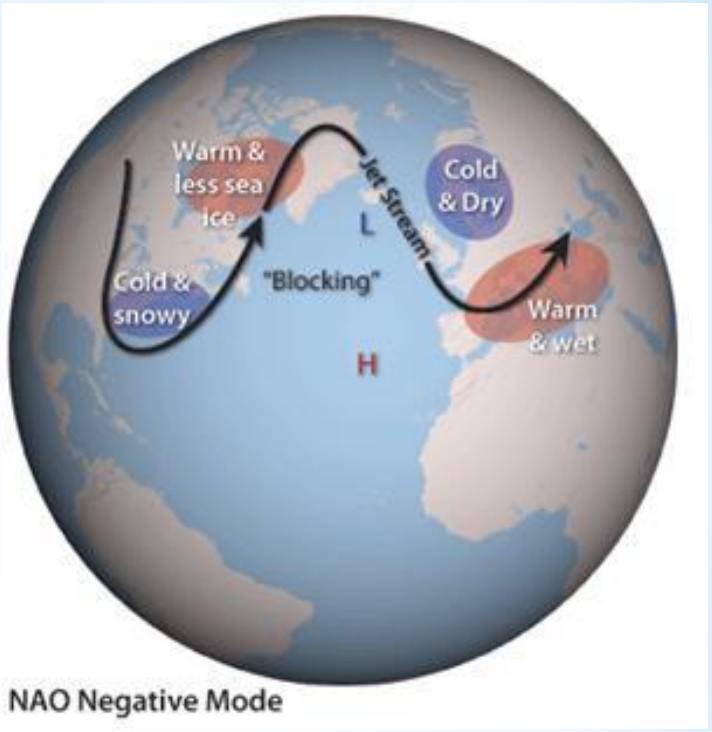
Weather Set-up Winter 2010 and Spring 2011

David Bernhardt

National Weather Service Great Falls



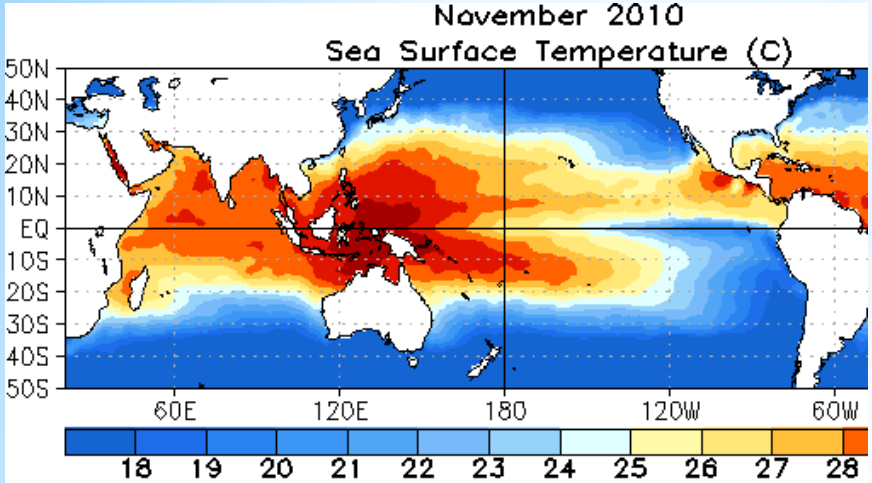
Moderate (-1.2C)

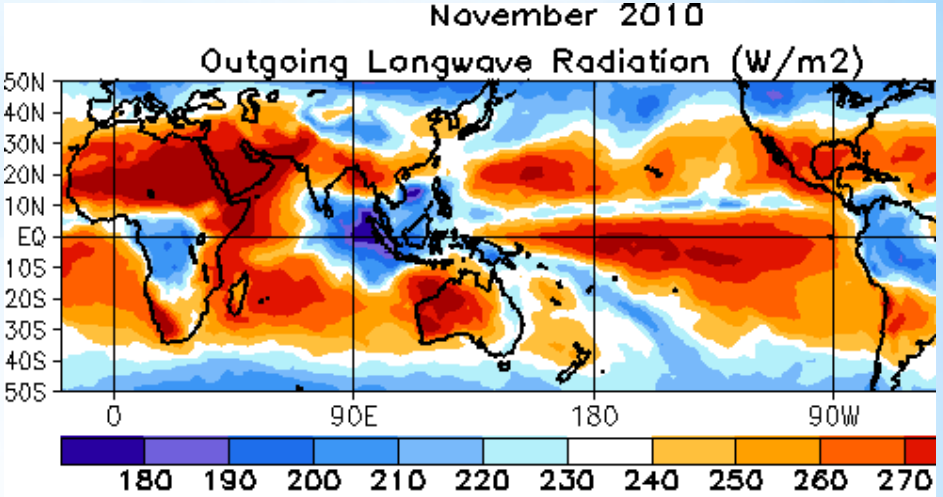


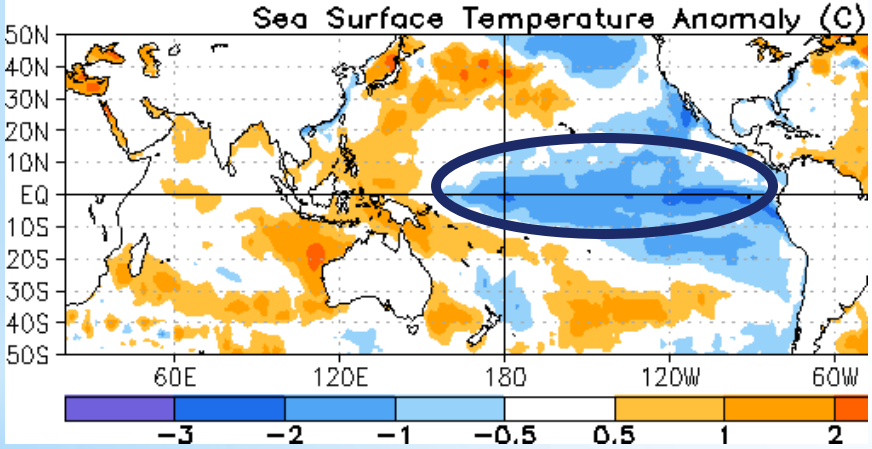
(-1.9C) North Atlantic Oscillation

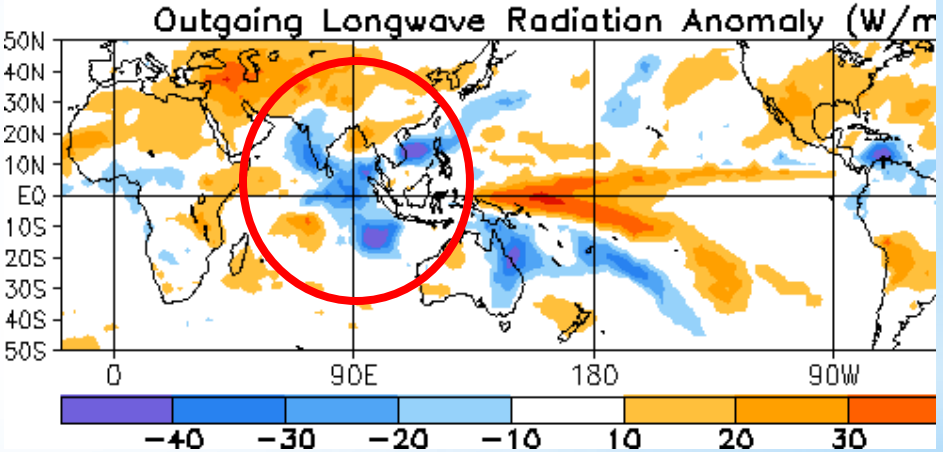
*What caused all of it?

One of few times that NAO, AO, PDO and ENSO were all strongly negative
NAO negative from Nov 2009 – Jan 2011.





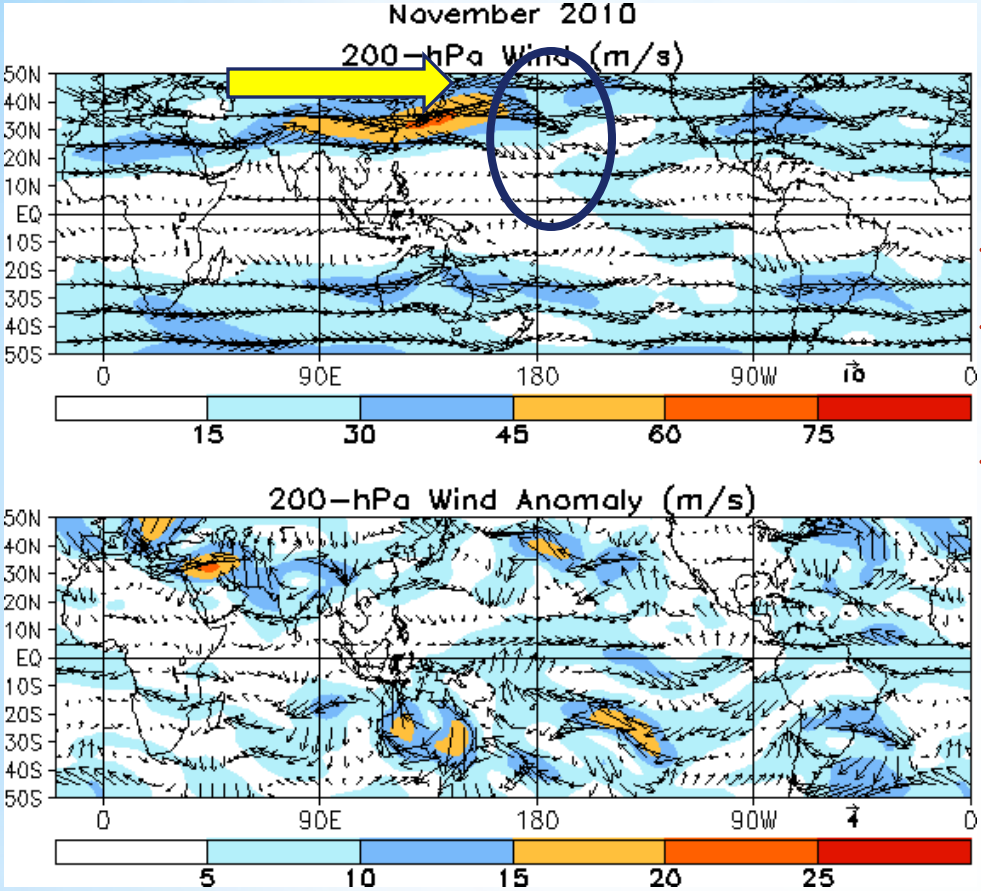




*How did we get here

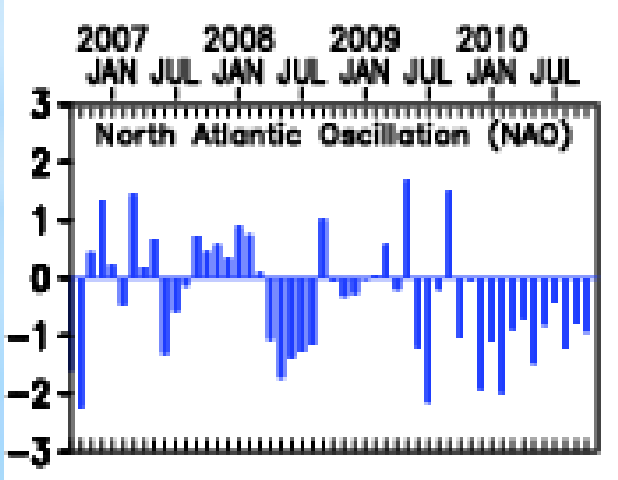
La Nina

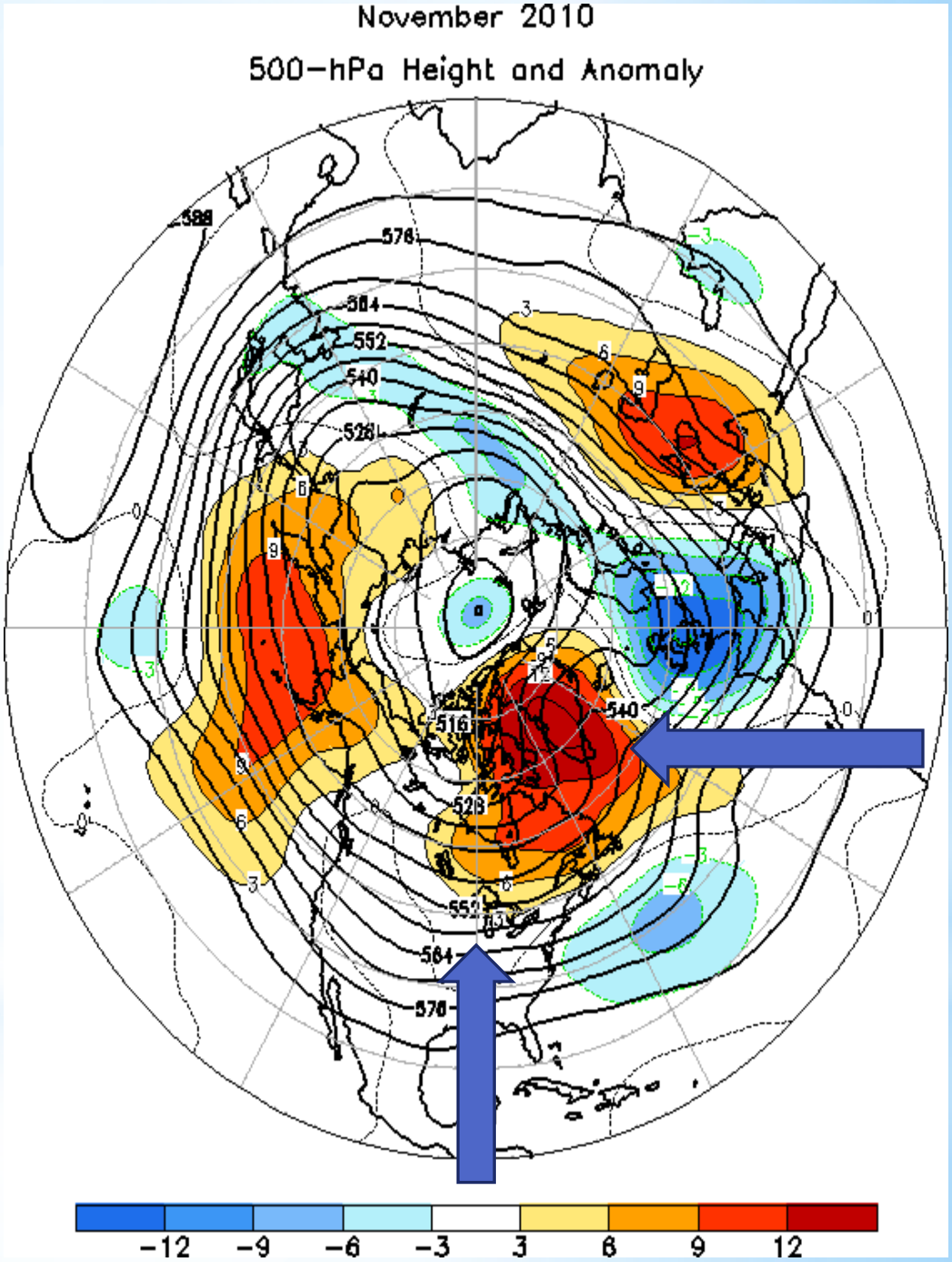
westward position of convection

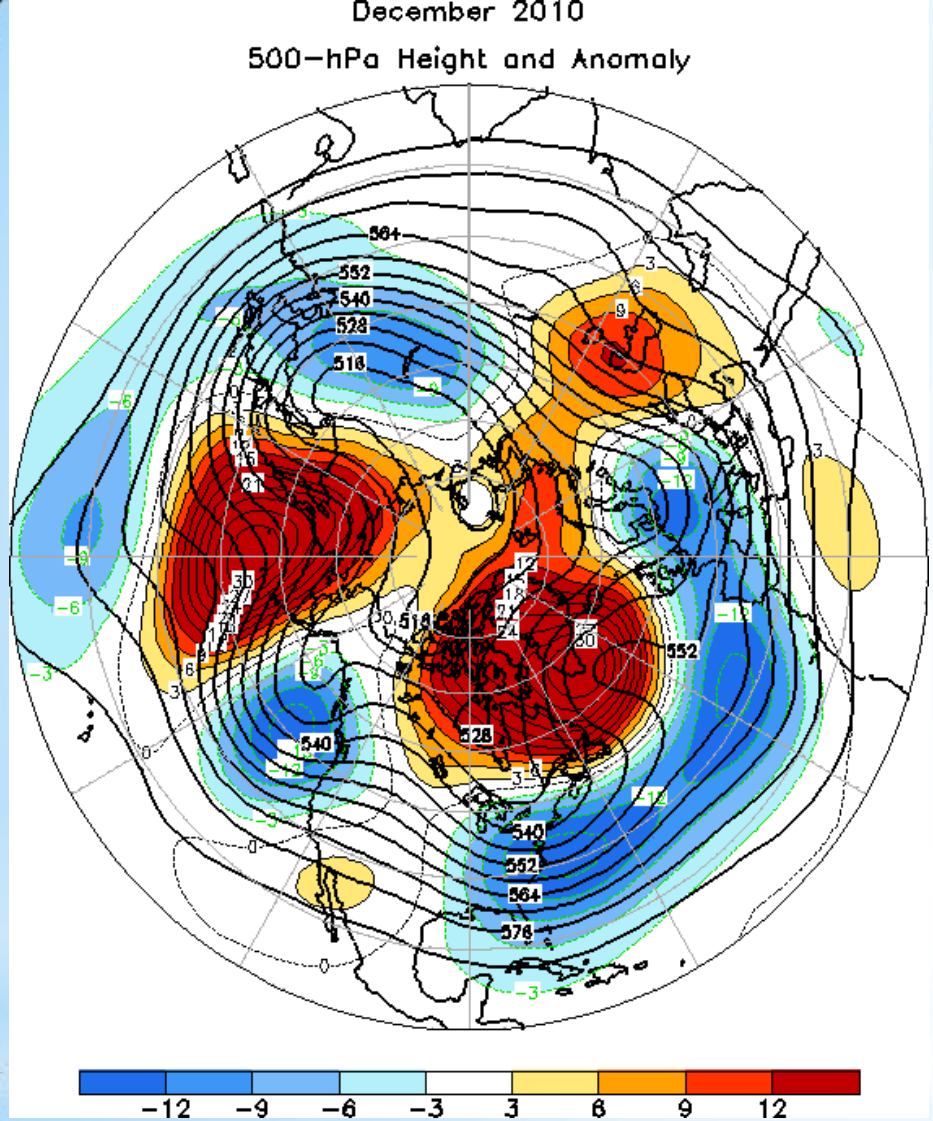


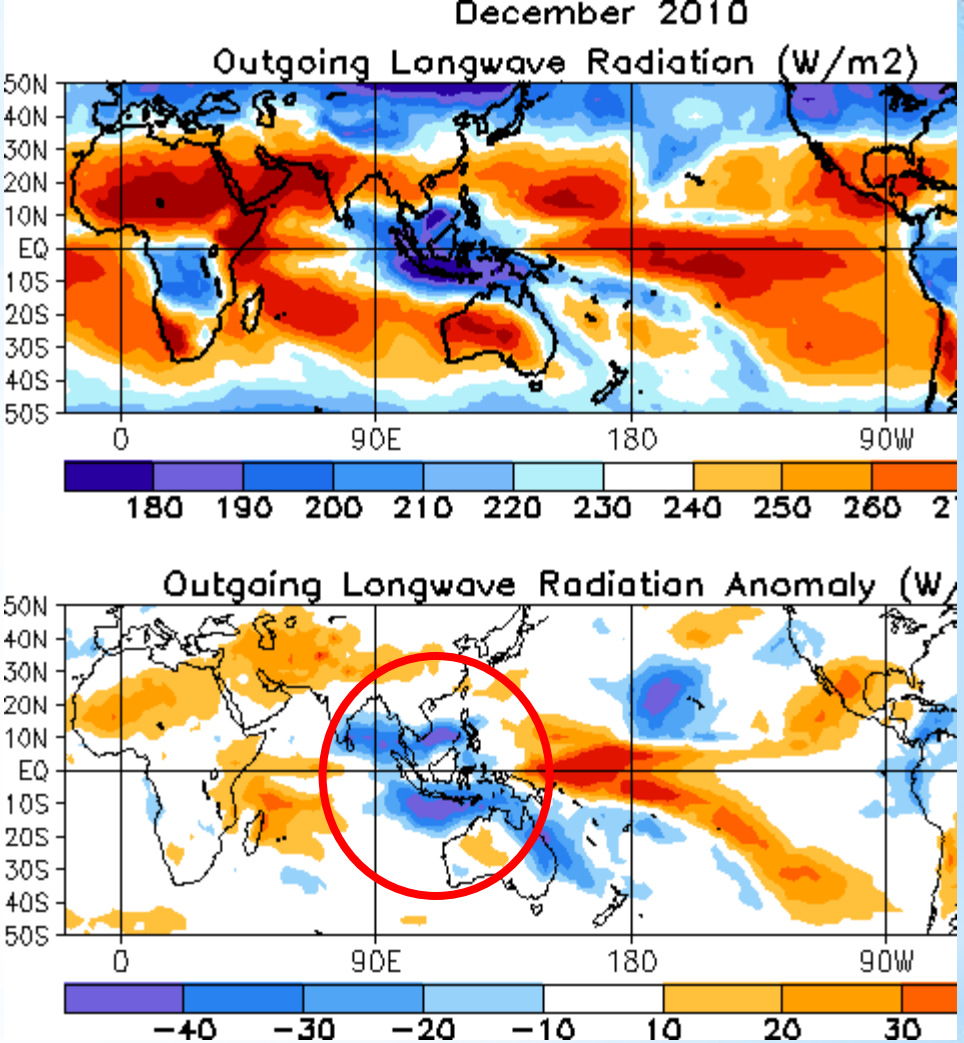
* 1. Amplifies mid-Pacific trough
* 2. Westward placement of east Asian jet stream.
* 3. Favors westward shift of downstream ridge/trough normally over western/eastern North America

- Broad trough over North America.
- NAO results (NAO negative since Nov 2009)
  - Ridge over Greenland
  - Southward shift of North Atlantic jet
  - Disappearance of Hudson Bay Trough/Low



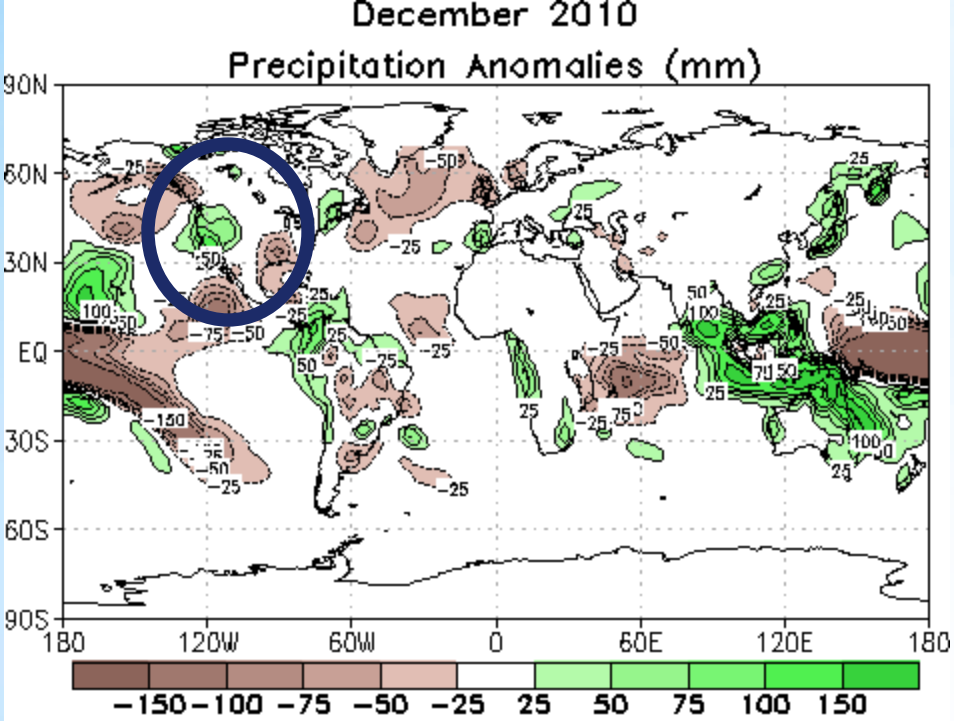


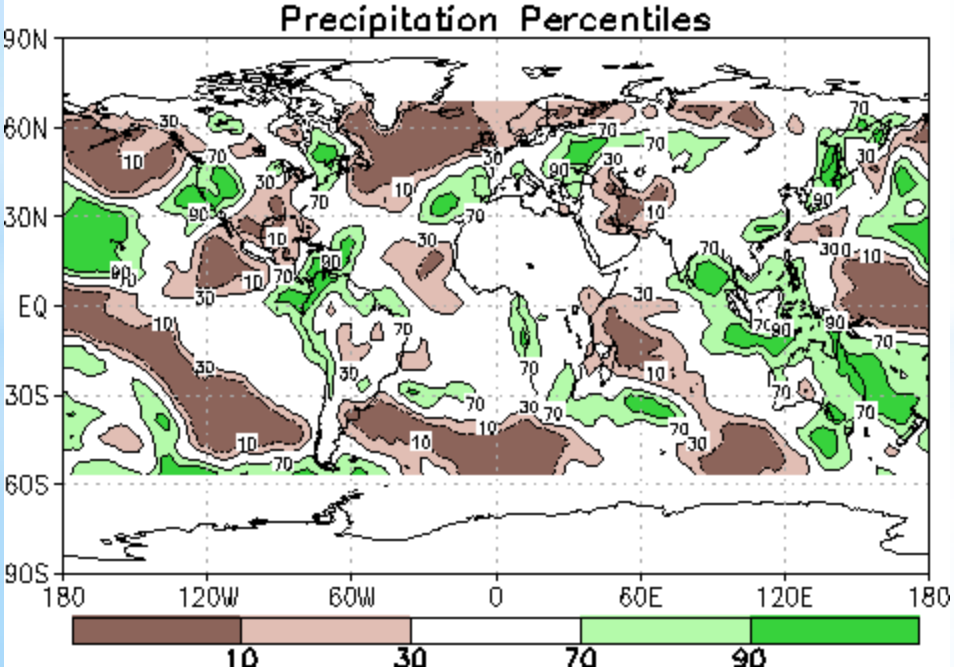




Ridge Greenland, west coast trough, convection over Indonesia

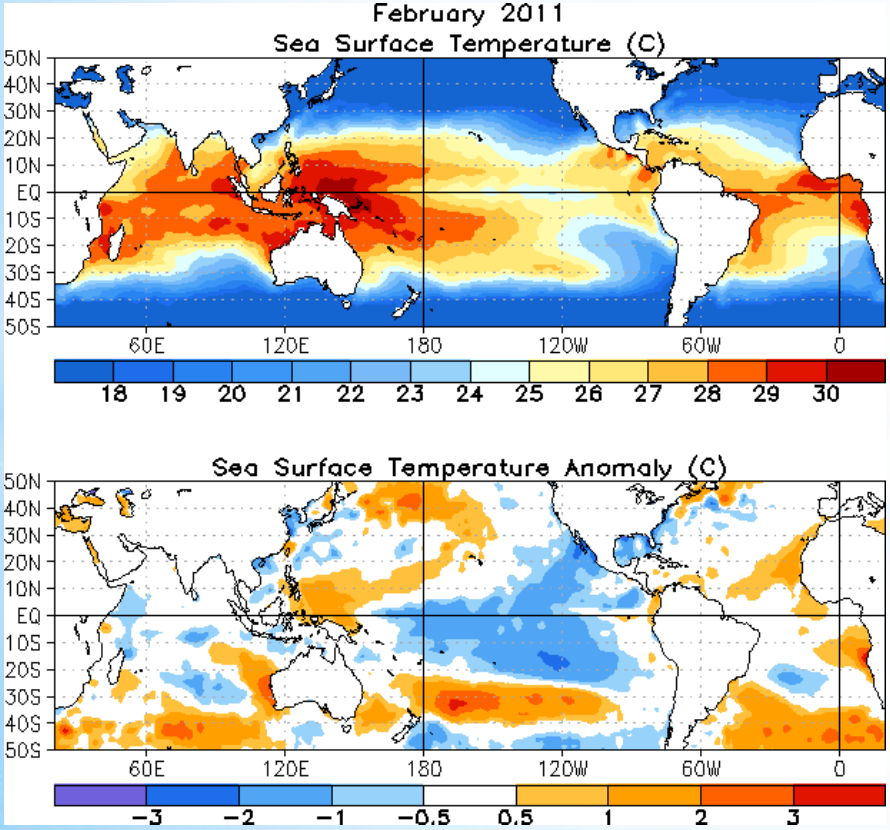
*Pattern Intensified in Dec 2010 and continued in Jan 2011

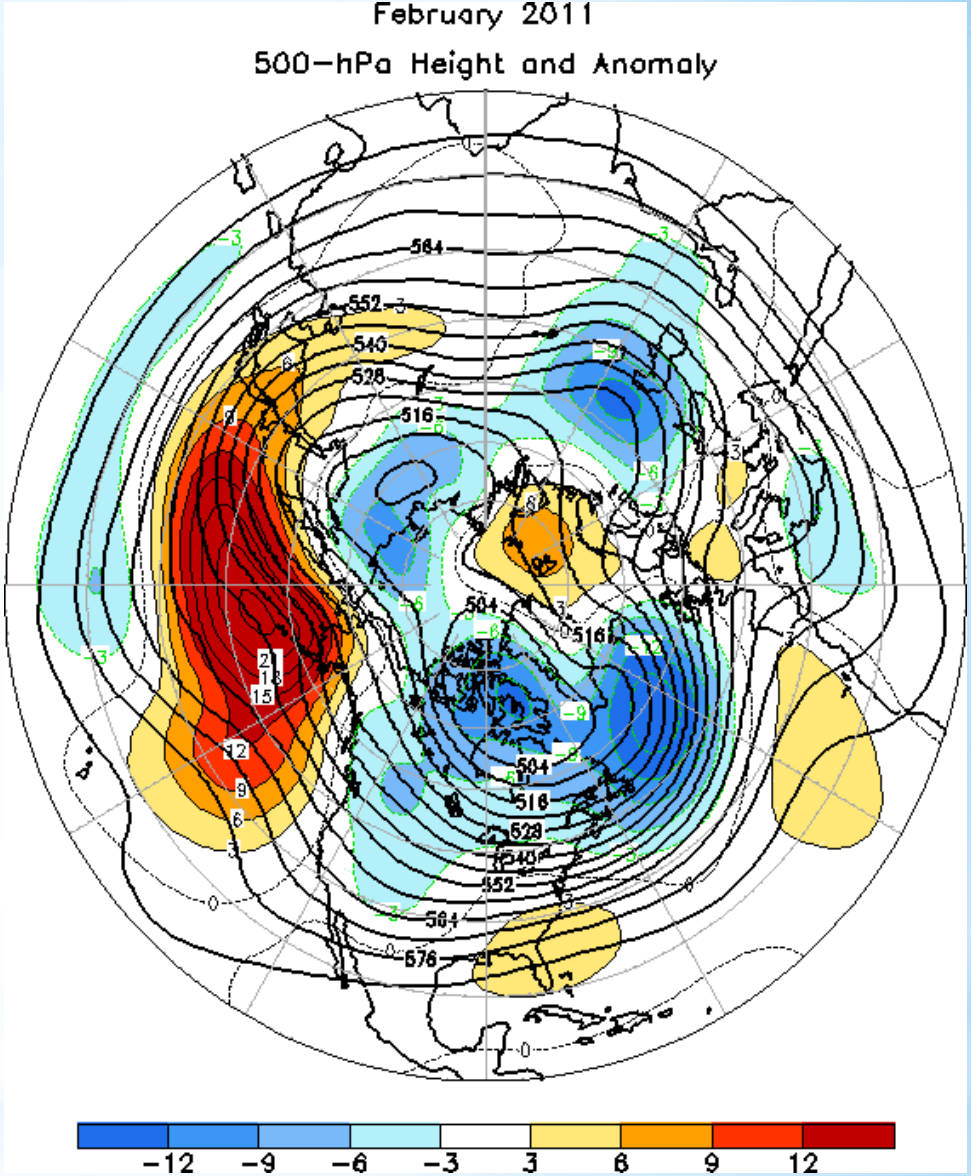




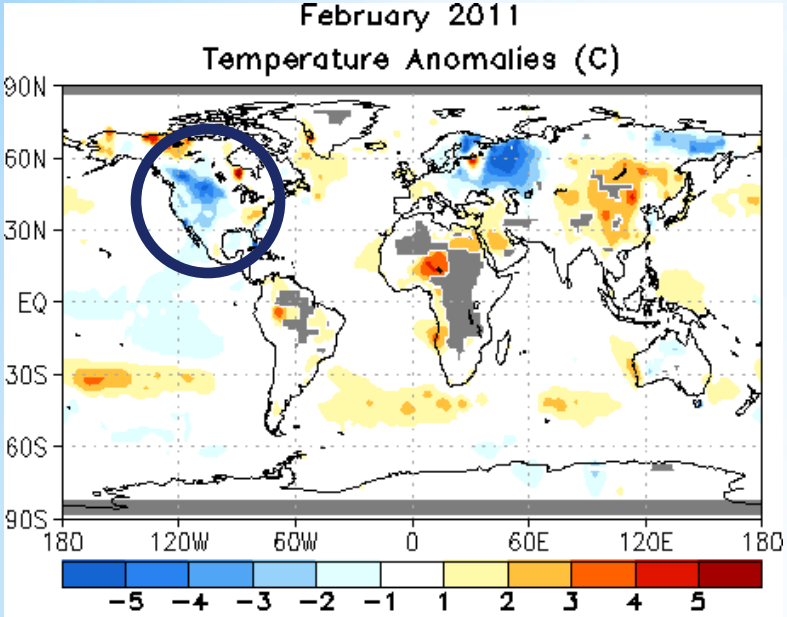
* Above normal Precip northwest US Dec and for all winter.
* Dec 2010-Feb 2011
  * Snowiest winter since 1907.

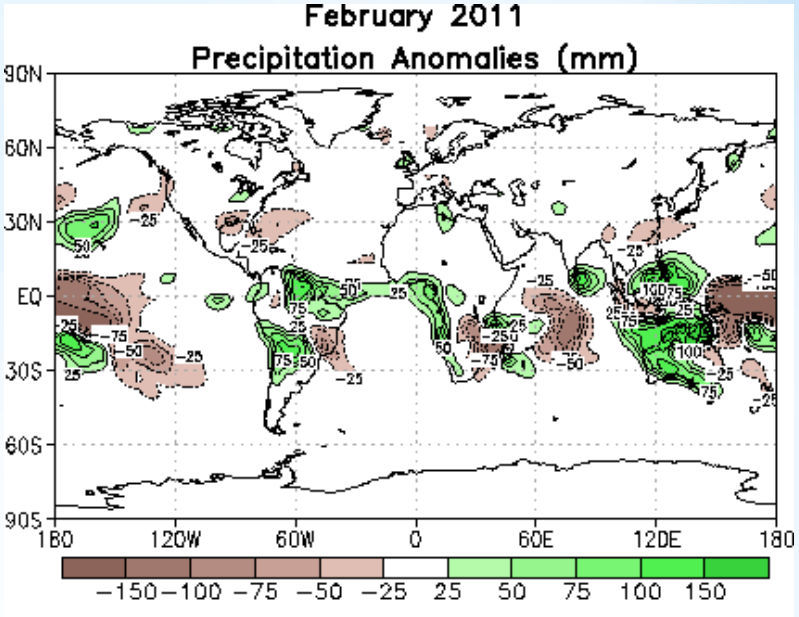
* Pattern influenced by mature La Nina, but now weakening
* First in 16 months *not* strongly influenced by NAO

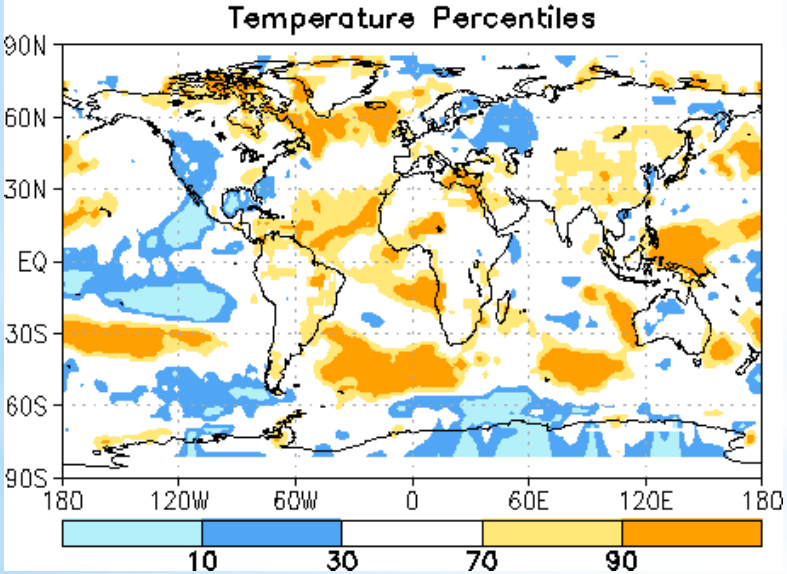


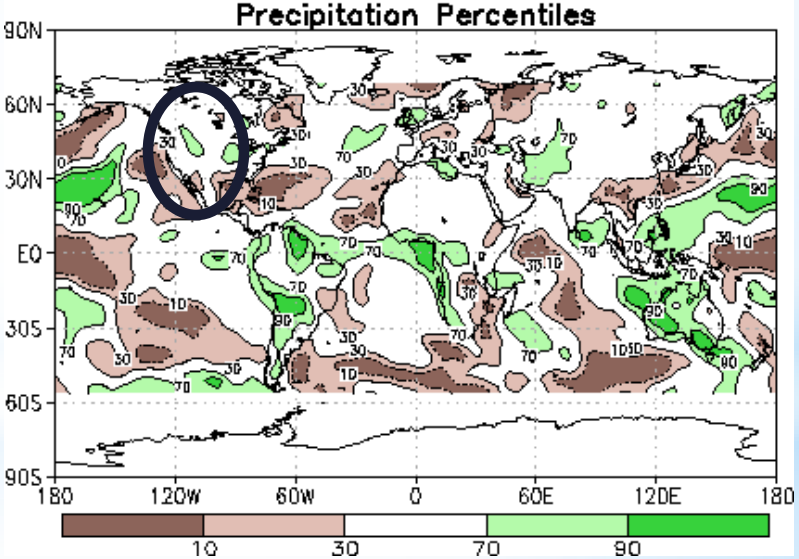


* Feb 2011



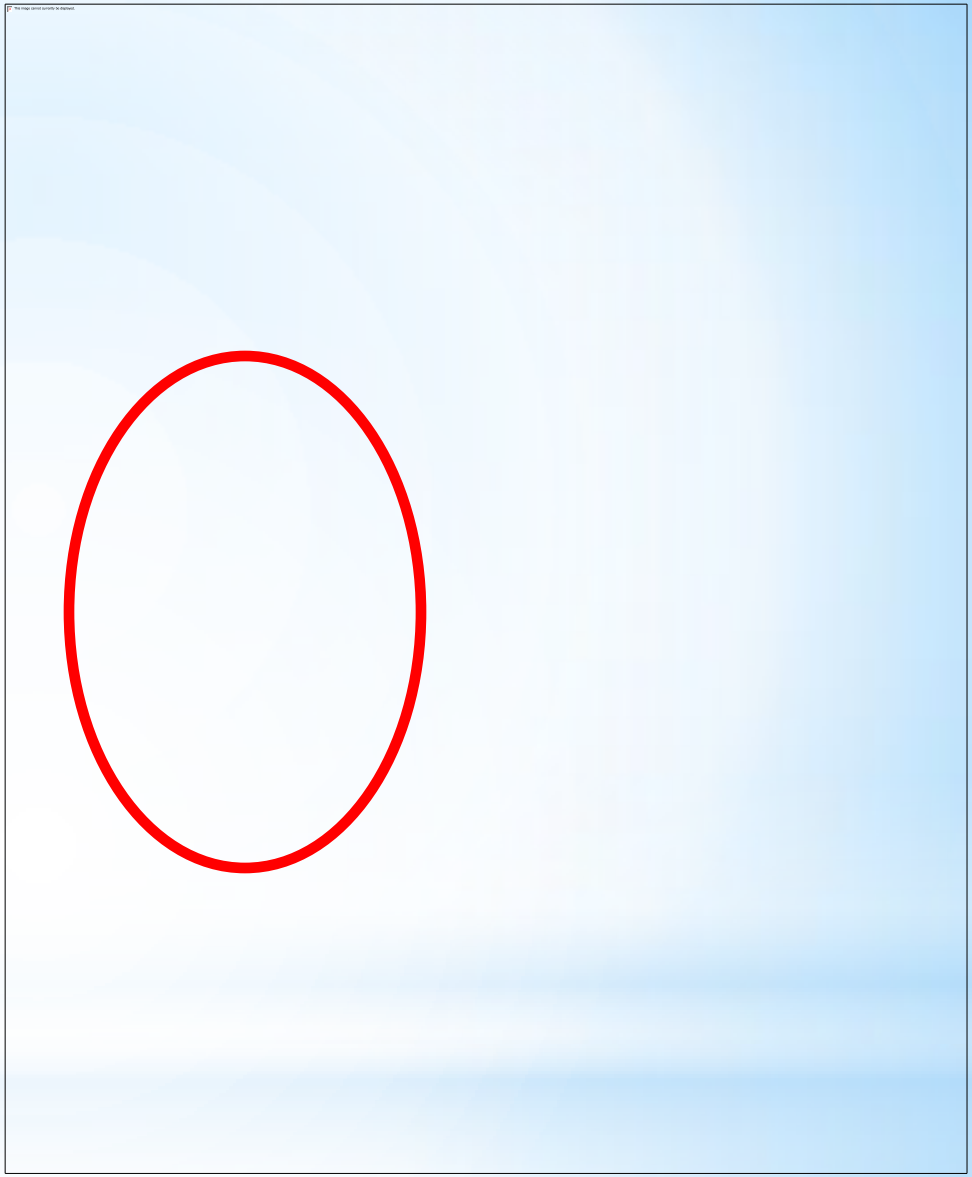


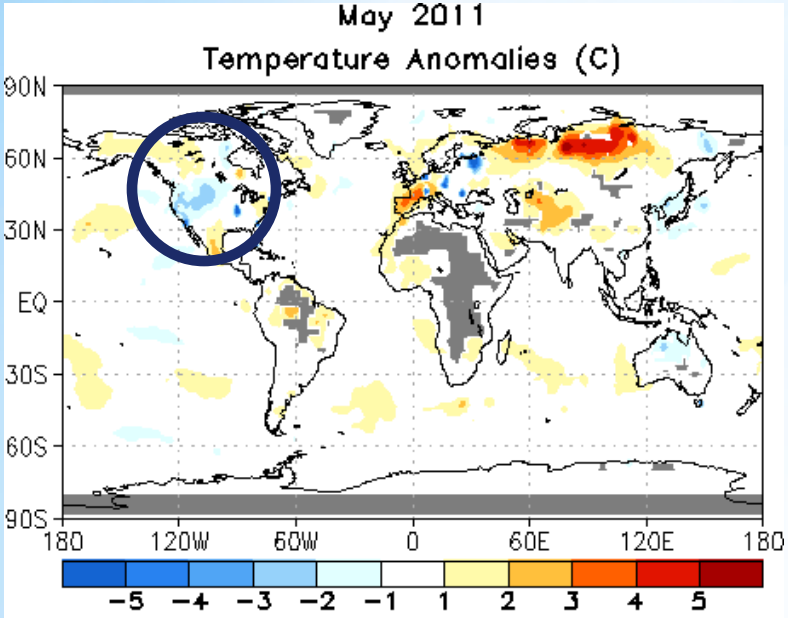


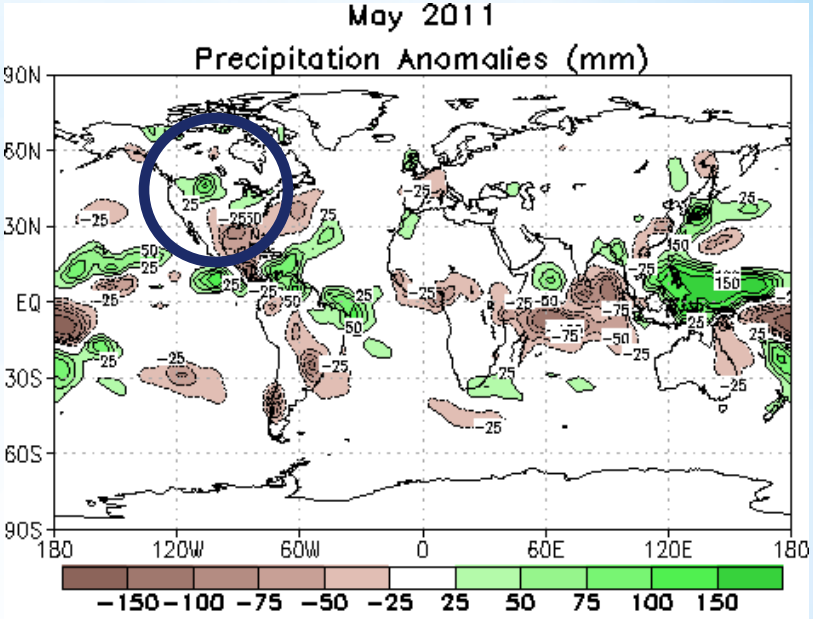


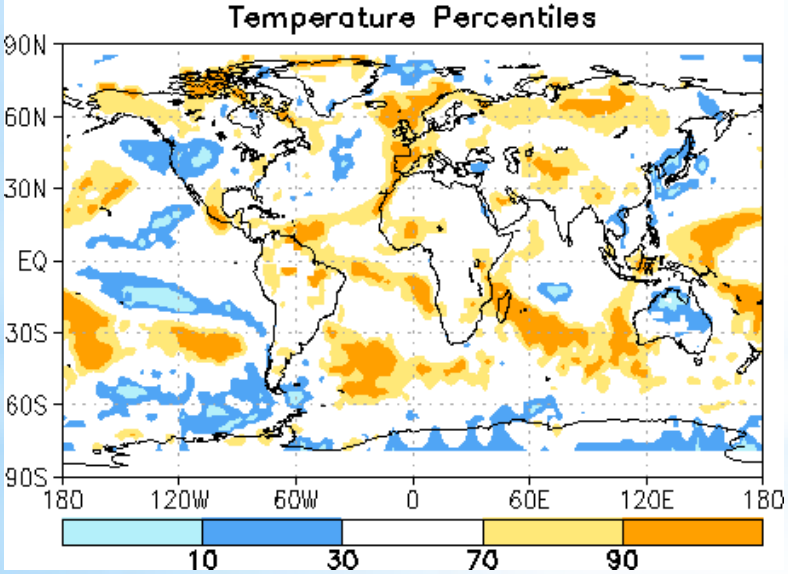
Cold across northwest US, small area of above normal precipitation

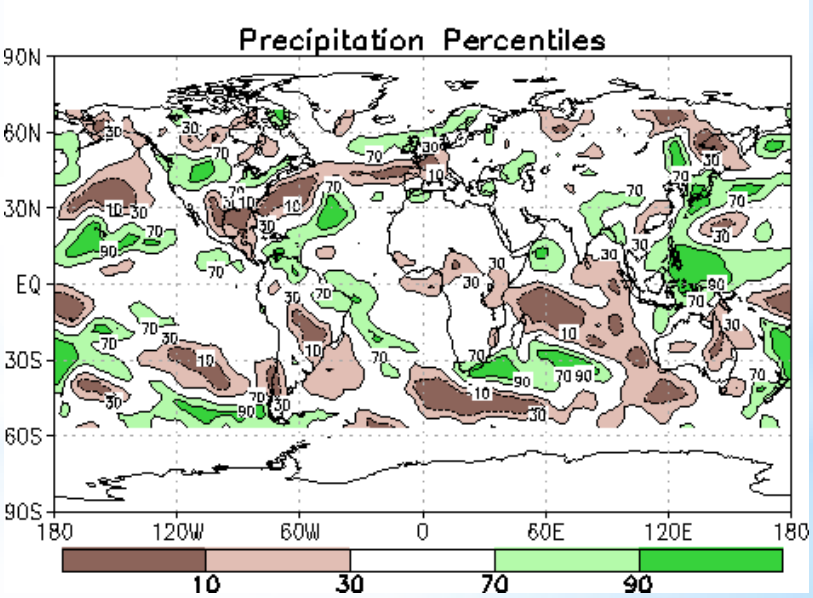
* Stronger than normal west Pacific trough to W US.
* More storms and above normal precip northern tier of US.
* Suppressed convection continues trough over Pacific
  * But slipping eastward



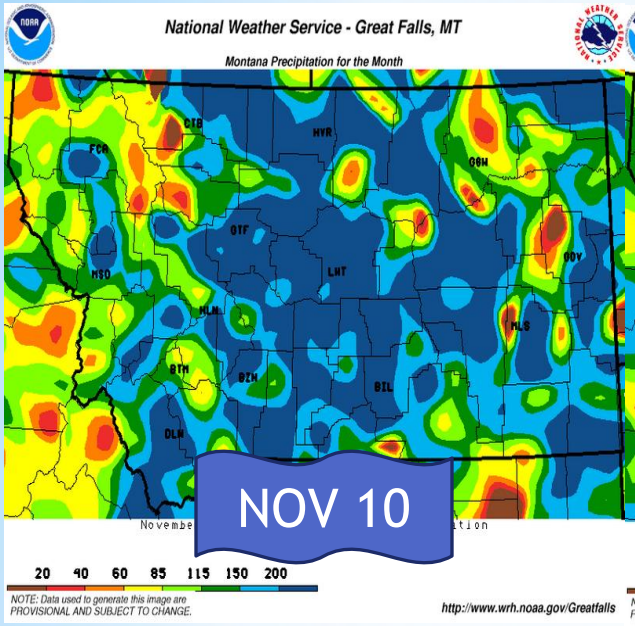


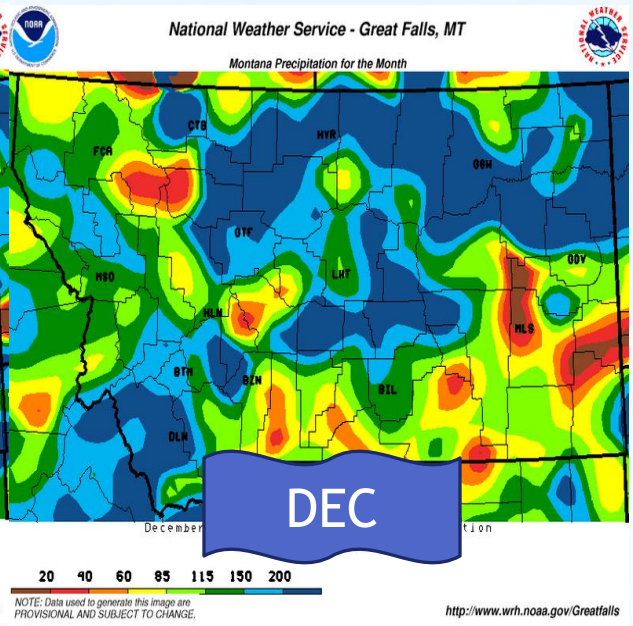


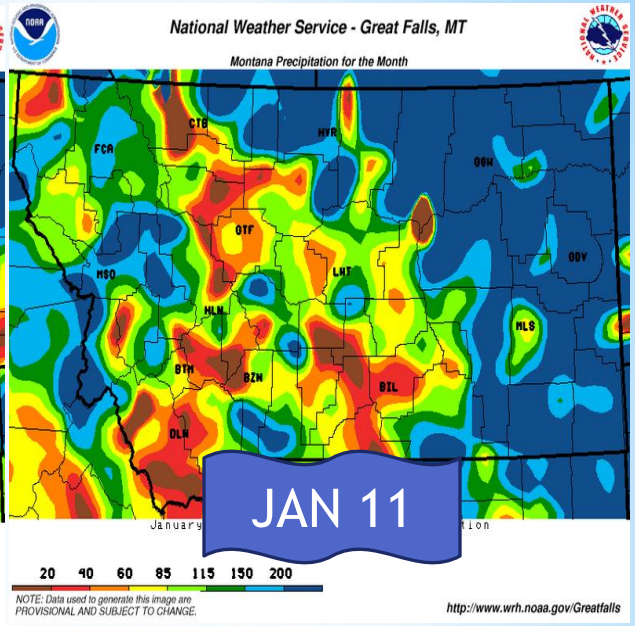


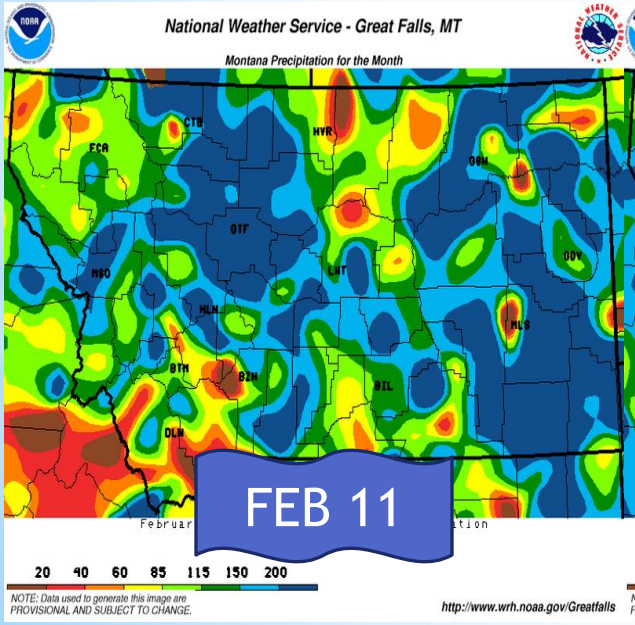


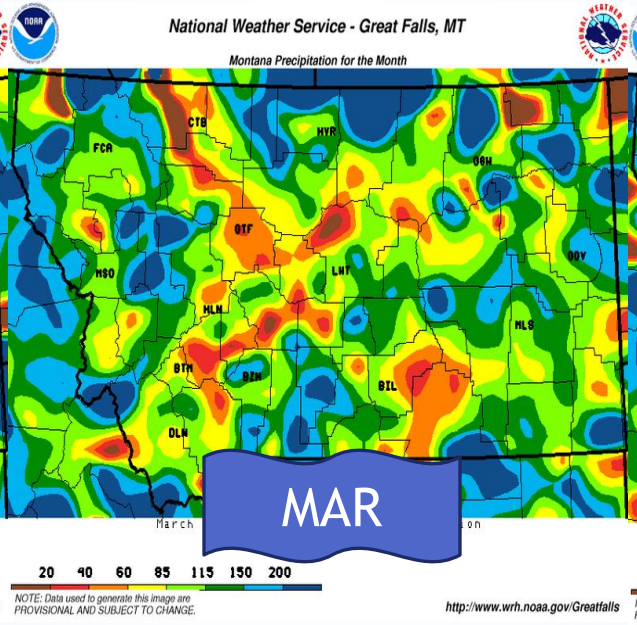
Cold across northwest US, above normal precipitation; second wettest of record in MT (90th percentile). Spring wettest of record by over ½ inch (7.15”)

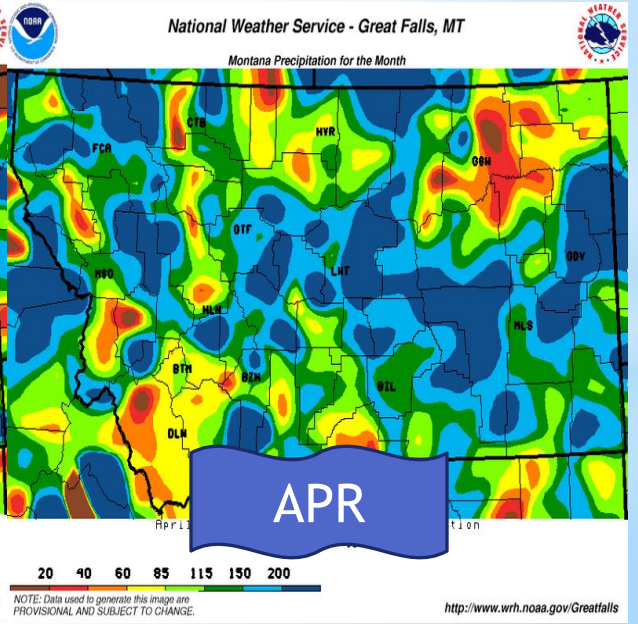




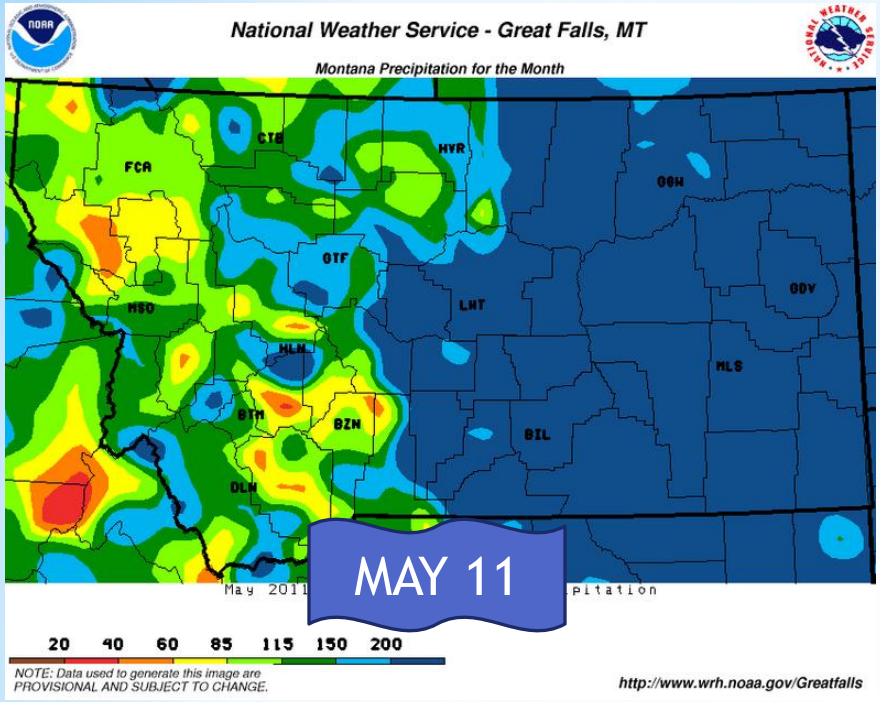


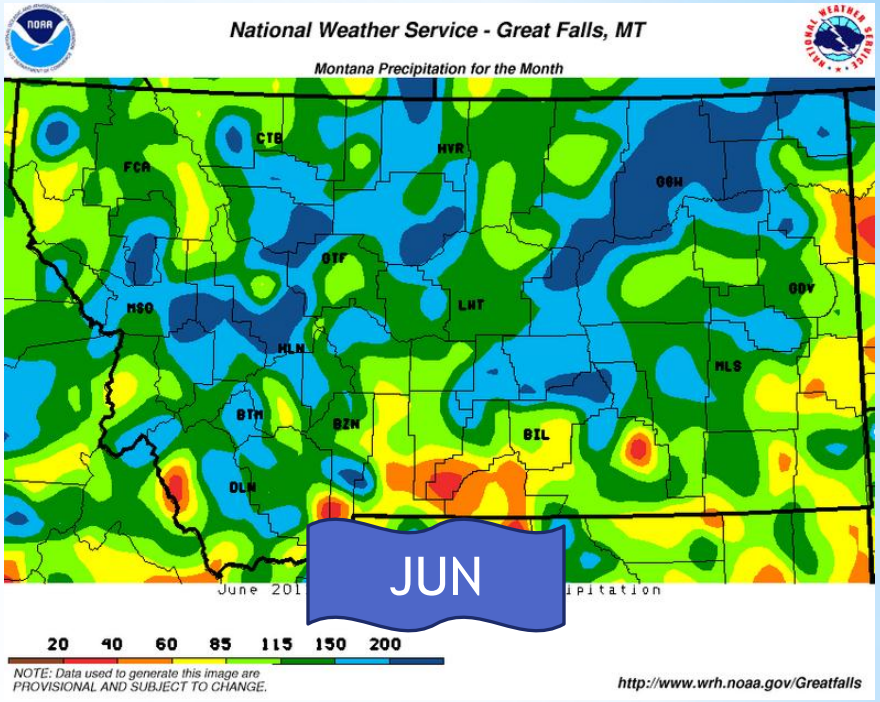


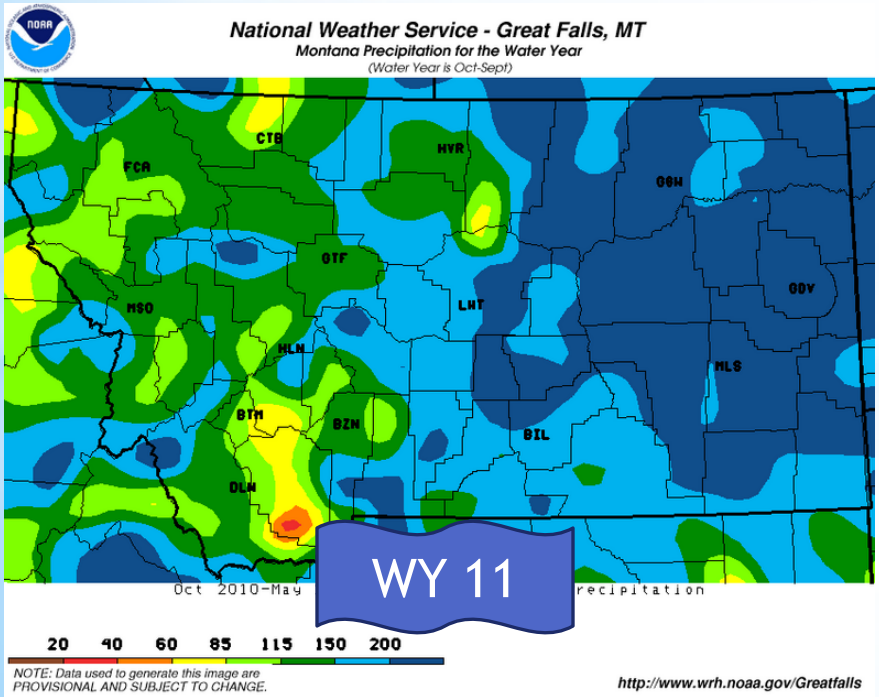




November 2010 – April 2011 Precipitation anomalies





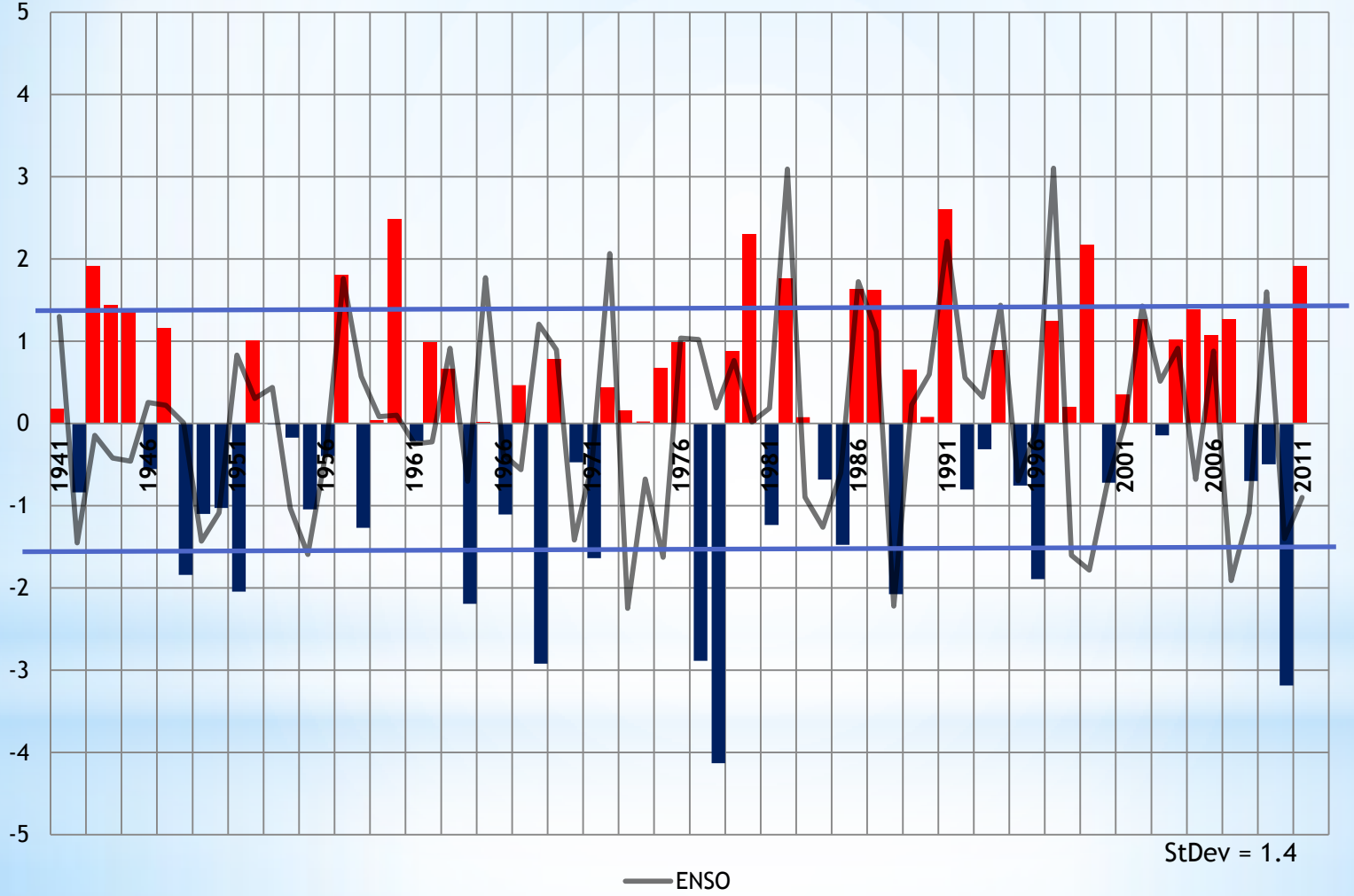


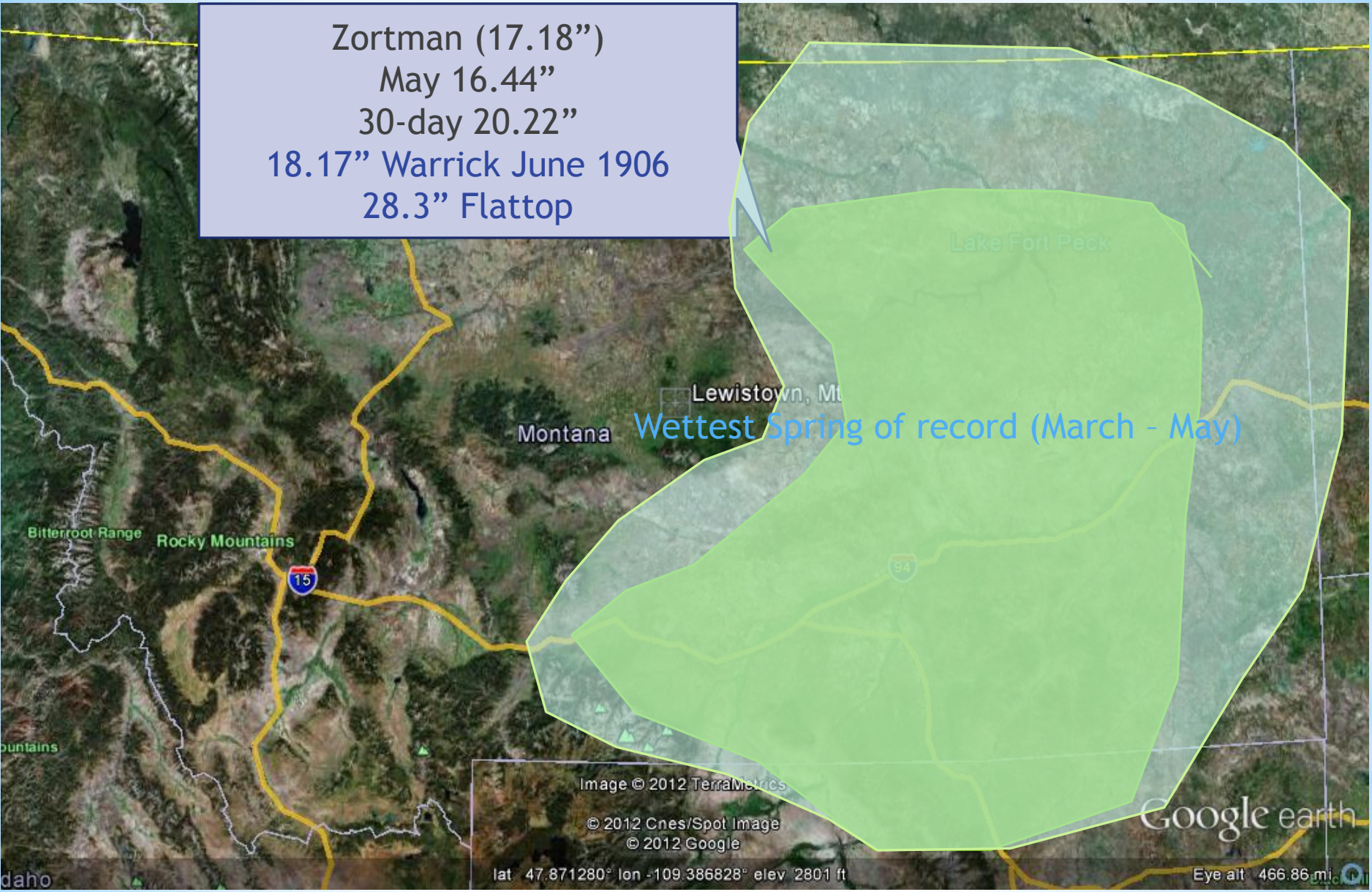
* Persistently high precip amounts
* Water-year very wet eastern MT

Winter Severity Index with ENSO trace Eastern Montana

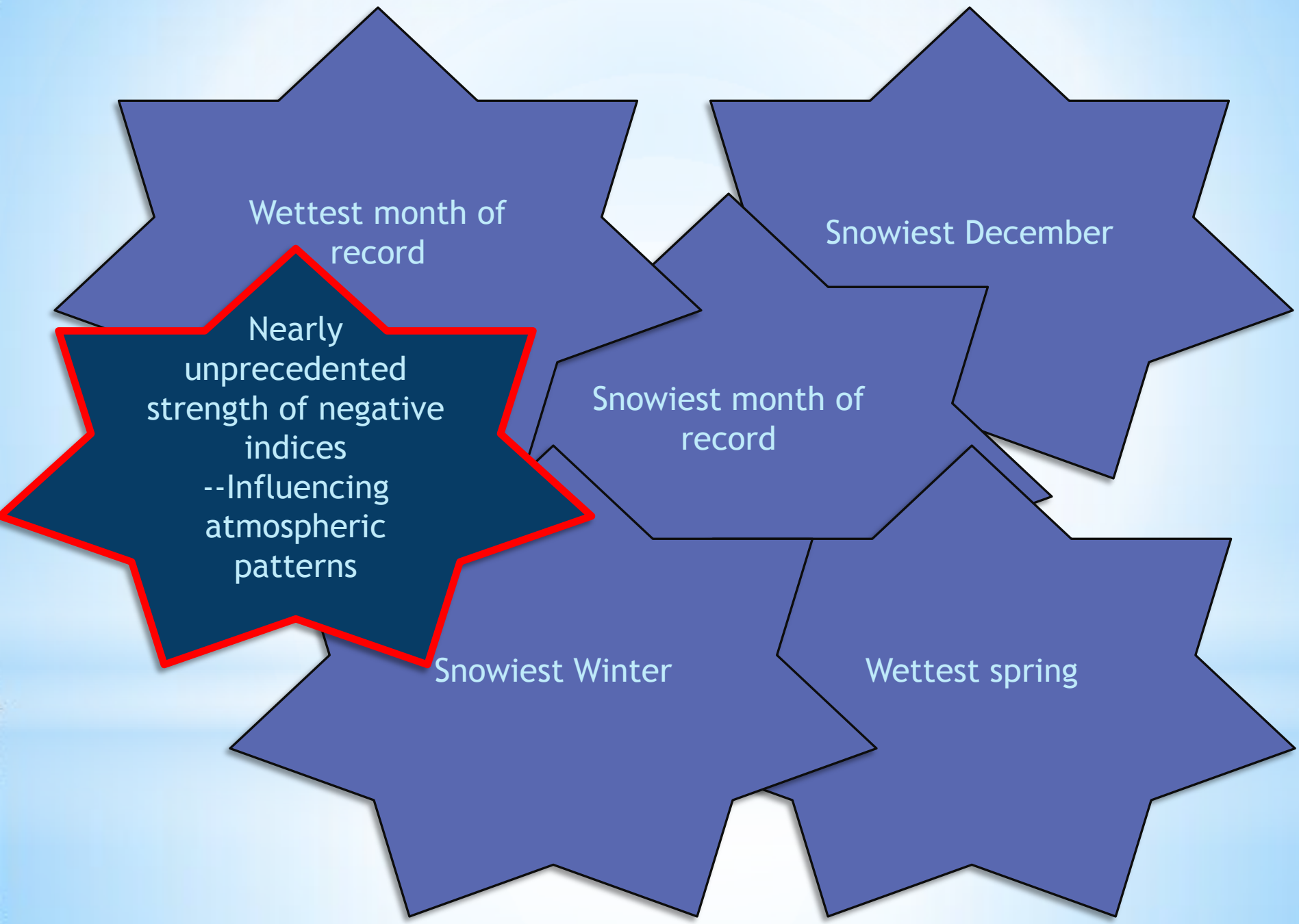
(Billings, Cut Bank, Havre, Helena, Glasgow, Glendive, Great Falls, Lewistown)

(index includes snowfall [15%], mean winter temperature [18%] and extreme





Wettest May or wettest month of record


Wettest month of record
Snowiest December
Nearly unprecedented strength of negative indices --Influencing atmospheric patterns
Snowiest month of record
Snowiest Winter
Wettest spring

Jul 2010	Going-to-Sun la	Latest snow melt dates of record mountain locations.
Sep 2010	MT driest soil moisture va	Cntrl MT – Driest summer of record.
Oct 2010	All-Time record warm temperature (97F).	

Thank You!

Questions?